CONTENTS

	Page
Announcement of Weekly Publication. D. F. HOUSTON	i
Effect of Alkali Salts in Soils on the Germination and Growth of Crops. FRANK S. HARRIS	1
Histological Relations of Sugar-Beet Seedlings and Phoma betae. H. A. EDSON	55
Perennial Mycelium in Species of Peronosporaceae Related to Phytophthora infestans. I. E. MELHUS	59
Hibernation of Phytophthora infestans in the Irish Potato. I. E. MELHUS	71
Enzyms of Apples and their Relation to the Ripening Process. R. W. THATCHER	103
An Automatic Transpiration Scale of Large Capacity for Use with Freely Exposed Plants. LYMAN J. BRIGGS and H. L. SHANTZ	117
Parasitism of Comandra umbellata. GEORGE GRANT HEDGCOCK	133
Separation of Soil Protozoa. NICHOLAS KOPELOFF, H. CLAY LINT, and DAVID A. COLEMAN	137
Effect of Temperature on Movement of Water Vapor and Capillary Moisture in Soils. G. J. BOUYOUCOS	141
Soil Temperatures as Influenced by Cultural Methods. JOSEPH OSKAMP	173
Alternaria panax, the Cause of a Root-Rot of Ginseng. J. ROSENBAUM and C. L. ZINNSMEISTER	181
Some Potato Tuber-Rots Caused by Species of Fusarium. C. W. CARPENTER	183
Infection Experiments with Timothy Rust. E. C. STAKMAN and LOUISE JENSEN	211
Experiments in the Use of Current Meters in Irrigation Canals. S. T. HARDING	217
Relation of Sulphur Compounds to Plant Nutrition. E. B. HART and W. E. TOTTINGHAM	233
Distribution of the Virus of the Mosaic Disease in Capsules, Filaments, Anthers, and Pistils of Affected Tobacco Plants. H. A. ALLARD	251
Dissemination of Bacterial Wilt of Cucurbits. FREDERICK V. RAND	257

Page

Gossypol, the Toxic Substance in Cottonseed Meal. W. A. WITHERS and F. E. CARRUTH 261

Two New Hosts for Peridermium pyriforme. GEORGE GRANT HEDGCOCK and WILLIAM H. LONG 289

Pathogenicity and Identity of Sclerotinia libertiana and Sclerotinia smilacina on Ginseng. J. ROSENBAUM 291

An Improved Respiration Calorimeter for Use in Experiments with Man. C. F. LANGWORTHY and R. D. MILNER 299

Occurrence of Manganese in Wheat. WILLIAM P. HEADDEN 349

Ash Composition of Upland Rice at Various Stages of Growth. P. L. GILE and J. O. CARRERO 357

Varietal Resistance of Plums to Brown-Rot. W. D. VALLEAU 365

Frequency of Occurrence of Tumors in the Domestic Fowl. MAYNIE R. CURTIS 397

Inheritance of Length of Pod in Certain Crosses. JOHN BELLING 405

A Honeycomb Heart-Rot of Oaks Caused by Stereum subpileatum. WILLIAM H. LONG 421

Measurement of the Winter Cycle in the Egg Production of Domestic Fowl. RAYMOND PEARL 429

Influence of Growth of Cowpeas upon Some Physical, Chemical, and Biological Properties of Soil. C. A. LECLAIR 439

Translocation of Mineral Constituents of Seeds and Tubers of Certain Plants During Growth. G. DAVIS BUCKNER 449

Fate and Effect of Arsenic Applied as a Spray for Weeds. W. T. MCGEORGE 459

Angular Leaf-Spot of Cucumbers. ERWIN F. SMITH and MARY KATHERINE BRYAN 465

Activity of Soil Protozoa. GEORGE P. KOCH 477

Beriberi and Cottonseed Poisoning in Pigs. GEORGE M. ROMMEL and EDWARD B. VEDDER 489

Biology of Apanteles militaris. DANIEL G. TOWER 495

Respiration Experiments with Sweet Potatoes. HEINRICH HASSELBRING and LON A. HAWKINS 509

Cherry and Hawthorn Sawfly Leaf Miner. P. J. PARROTT and B. B. FULTON 519

Variations in Mineral Composition of Sap, Leaves, and Stems of the Wild-Grape Vine and Sugar-Maple Tree. O. M. SHEDD 529

Carbohydrate Transformations in Sweet Potatoes. HEINRICH HASSELBRING and LON A. HAWKINS 543

Diuresis and Milk Flow. H. STEENBOCK 561

Page

Petrography of Some North Carolina Soils and Its Relation to Their Fertilizer Requirements. J. K. PLUMMER 569

Hourly Transpiration Rate on Clear Days as Determined by Cyclic Environmental Factors. LYMAN J. BRIGGS and H. L. SHANTZ 583

Effect of Natural Low Temperature on Certain Fungi and Bacteria. H. E. BARTRAM 651

Effect of Cold-Storage Temperatures upon the Mediterranean Fruit Fly. E. A. BACK and C. E. PEMBERTON 657

Biochemical Comparisons between Mature Beef and Immature Veal. WILLIAM N. BERG 667

Factors Involved in the Growth and the Pycnidium Formation of Plenodomus fuscomaculans. GEORGE HERBERT COONS 713

Effect of Elemental Sulphur and of Calcium Sulphate on Certain of the Higher and Lower Forms of Plant Life. WALTER PITZ .. 771

A Serious Disease in Forest Nurseries Caused by Peridermium filamentosum. JAMES R. WEIR and ERNEST E. HUBERT 781

Sweet-Potato Scurf. L. L. HARTER 787

Banana as a Host Fruit of the Mediterranean Fruit Fly. E. A. BACK and C. E. PEMBERTON 793

Effect of Controllable Variables upon the Penetration Test for Asphalts and Asphalt Cements. PRÉVOST HUBBARD and F. P. PRITCHARD 805

Effects of Refrigeration upon the Larvæ of Trichinella spiralis. B. H. RANSOM 819

Relation Between Certain Bacterial Activities in Soils and Their Crop-Producing Power. PERCY EDGAR BROWN 855

Agglutination Test as a Means of Studying the Presence of Bacterium abortus in Milk. L. H. COOLEDGE 871

Boron: Its Absorption and Distribution in Plants and Its Effect on Growth. F. C. COOK 877

Further Studies on Peanut Leafspot. FREDERICK A. WOLF 891

Relation Between the Properties of Hardness and Toughness of Road-Building Rock. PRÉVOST HUBBARD and F. H. JACKSON, Jr 903

Nitrogen Content of the Humus of Arid Soils. FREDERICK J. ALWAY and EARL S. BISHOP 909

Life-History Studies of the Colorado Potato Beetle. PAULINE M. JOHNSON and ANITA M. BALLINGER 917

Page

Some Factors Influencing the Longevity of Soil Micro-organisms Subjected to Desiccation, with Special Reference to Soil Solution. WARD GILTNER and H. VIRGINIA LANGWORTHY 927

Observations on the Life History of the Cherry Leaf Beetle. GLENN W. HERRICK and ROBERT MATHESON 943

Apparatus for Measuring the Wear of Concrete Roads. A. T. GOLDBECK 951

Morphology and Biology of the Green Apple Aphis. A. C. BAKER and W. F. TURNER 955

Soilstain, or Scurf, of the Sweet Potato. J. J. TAUBENHAUS 995

An Asiatic Species of Gymnosporangium Established in Oregon. H. S. JACKSON 1003

Relation of Stomatal Movement to Infection by Cercospora beticola. VENUS W. POOL and M. B. MCKAY 1011

A Method of Correcting for Soil Heterogeneity in Variety Tests. FRANK M. SURFACE and RAYMOND PEARL 1039

Flow through Weir Notches with Thin Edges and Full Contractions. V. M. CONE 1051

Identity of Eriosoma pyri. A. C. BAKER 1115

A New Penetration Needle for Use in Testing Bituminous Materials. CHARLES S. REEVE and FRED P. PRITCHARD 1121

A New Irrigation Weir. V. M. CONE 1127

Inheritance of Fertility in Swine. EDWARD N. WENTWORTH and C. E. AUBEL 1145

Relation of Green Manures to the Failure of Certain Seedlings. E. B. FRED 1161

A New Spray Nozzle. C. W. WOODWORTH 1177

A New Interpretation of the Relationships of Temperature and Humidity to Insect Development. W. DWIGHT PIERCE 1183

Index 1193

ERRATA

Page 20, last line, "ammonium sulphate" should read "ammonium carbonate."

Page 22, legend under figure 16 should read "Diagram showing the number of corn plants up and dry matter produced in 21 days on College loam with sodium sulphate, sodium carbonate, and sodium chlorid," etc.

Page 23, legend under figure 18 should read "Diagram showing the number of wheat plants up and dry matter produced in 16 days on Greenville loam with ammonium carbonate, sodium carbonate, and potassium carbonate," etc.

Page 59, "*Dipsacus follonum*" should read "*Dipsacus fullonum*."

Page 63, "*Capsula bursa pastoris*" should read "*Capsella bursa pastoris*."

Pages 65, 66, 67, "*Helianthus diversicatus*" should read "*Helianthus divaricatus*."

Page 174, line 17 from bottom, "32°" should read "30°."

Page 175, Table II, last column, last line, "60.0" should read "67.0."

Page 189, line 13 from bottom, "form" should read "from."

Page 191, line 17 from bottom, "Fusarium Wollenw." should read "Fusarium hyperoxysporum Wollenw."

Page 210, Plate XVII, "figure 1" should read "figure 4," "figures 2, 3, 4" should read "figures 1, 2, 3."

Page 271, line 22, "weight of the kernels" should read "weight of the extracted kernels."

Page 272, line 8, "It was normal" should read "It was not normal."

Page 279, footnote b, "Rabbit 651" should read "Rabbit 951."

Page 291, "*Panax quinquefolia*" should read "*Panax quinquefolium*."

Page 334, line 11 from bottom should read "thermoelements in this section may be observed."

Page 694, line 7, "2 N 2/5" should read "N 2/5."

Page 700, line 14, "N/5" should read "N 2/5."

Page 752, footnote, line 2 from bottom, should read "For 100 c. c. synthetic solution take 1 c. c. of M/3 magnesium sulphate, 1 c. c. asparagin M/5, and 5 c. c. of each of the other solutions, and add to 88 c. c. water. Steam on three successive days."

Page 780, Plate LVI, figure 2, *B*, "0.1 per cent" should read "0.01 per cent."

Page 782, "*Pinus murrayana* Oreg. Com." should read "*Pinus contorta* Loud."

Page 911, line 13 from bottom should read "and a humid soil after the removal of lime and magnesia."

Page 912, line 10 from bottom should read "10 gm. of dry soil after the removal of lime and magnesia."

Plate LXVI, "Fig. 2" should read "Fig. 1."

Page 986, last line, "also" should read "next to."

Page 987, first footnote, "eighth" should read "seventh."

Page 1016, line 16, "comparing them" should read "comparable."

Page 1023, Table VII, first column, "12.15 a. m." should read "12.15 p. m."

Page 1036, line 4, "spore" should read "pore."

Page 1063, line 3, "4.0065 feet" should read "4.0056 feet."

Page 1071, figure 8 and tenth line from bottom of page, "$C=3.078L^{1.012}$" should read "$C=3.078L^{0.982}$."

Page 1073, line 17, "4.0058 feet" should read "4.0086 feet."

Page 1081, Table VIII, "4.0058-foot notch" should read "4.0086-foot notch."

Page 1083, bottom of page, "$H\left(2.5-\frac{0.0195}{S^{0.75}}\right)$" should read "$H\left(2.5-\frac{0.0195}{S^{0.79}}\right)$."

Page 1095, Table XIV, under "Head, 1 foot," ninth column, tenth line, "4.52" should read "4.53."

Page 1112, Literature cited, "Forschheimer" should read "Forchheimer."

Page 1117, legend under figure 1, end of line 6, "spring" should read "fall."

Page 1187, "22.9" should read "12.9."

ILLUSTRATIONS

PLATES

Historical Relations of Sugar-Beet Seedlings and Phoma betae

Page

Plate I. Fig. 1.—Section of a sugar-beet seedling invaded by *Phoma betae*, showing distribution of the mycelium and the action of the fungus on the protoplasm and cell walls. Fig. 2.—Section of sugar-beet seedling showing characteristic action of *Phoma betae* on the cytoplasm and nuclei and cell walls in cases of serious infection. Fig. 3.—Section of sugar-beet seedling, showing *Phoma betae* penetrating the cell walls and expanding in one of the cells. Fig. 4, 5, 6.—Abnormal nuclei from uninfected cells adjacent to invaded tissue of sugar-beet seedlings 58

Plate II. Fig. 1.—Section through a sugar-beet seedling which has recovered from an attack of *Phoma betae*, showing a young pycnidium of the fungus forming on the discarded, killed tissue. Fig. 2.—Longitudinal section through a sugar-beet seedling which had recovered from an attack of root sickness due to *Poma betae*, showing the presence of the fungus established in a condition of reduced virulence in the living cells 58

Perennial Mycelium in Species of Peronosporaceae Related to Phytophthora infestans

Plate III. Fig. 1.—*Cystopus candidus* on *Lepidium virginicum*. Fig. 2.—*A*, The two leaves at the left show the amount of sporulation of *Peronospora parasitica* on leaves of *Lepidium virginicum; B*, the two leaves at the right show *Cystopus candidus* fruiting on leaves of *Capsella bursa pastoris*. Fig. 3.—*Peronospora viciae* on *Vicia sepium* 70

Hibernation of Phytophthora infestans in the Irish Potato

Plate IV. *Phytophthora infestans:* Infection of potato tubers. Fig. 1.—Cross section of a tuber which was infected with *P. infestans* and was planted in the greenhouse in rather dry soil. Fig. 2.—This tuber was inoculated at the eye surrounded by the paraffin ring. Fig. 3.—Cross section of an infected tuber planted in sterilized soil in the greenhouse which developed a shoot that became infected through the parent tuber. Fig. 4.—The small stunted shoot which grew from this infected tuber shows the progressive discoloration caused by *P. infestans* growing up the stem 102

Plate V. *Phytopththora infestans:* Infection of a potato plant 102

Plate VI. *Phytophthora infestans:* Infection of potato shoots and plantlets. Fig. 1.—This shoot grew from a diseased tuber planted in the greenhouse under field conditions. Fig. 2.—This shoot, which had not reached the surface of the soil, grew from an infected tuber in the field. Fig. 3.—This plantlet was the progeny of a diseased tuber planted in the open 102

Plate VII. *Phytophthora infestans:* Infection of potato plants. Fig. 1.—A hill of potatoes having 13 shoots grown from a whole infected tuber in the field. Fig. 2.—In this hill with two shoots the fungus has reached the surface and killed its host. Fig. 3.—This shows the hill illustrated in figure 2, in its position in the row where it grew 102

Plate VIII. *Phytophthora infestans:* Infection of potato plots. Fig. 1.—A corner of the plots where infected seed potatoes were planted. Fig. 2.—The area within the white lines shows a spot where infection is much more prevalent than in the surrounding plants 102

AN AUTOMATIC TRANSPIRATION SCALE OF LARGE CAPACITY FOR USE WITH FREELY EXPOSED PLANTS

Page

PLATE IX. Fig. 1.—Four automatic balances in operation at Akron, Colo., June 19, 1912, with the front of the box containing the mechanism open. The recording device is shown just beyond the first box. Fig. 2.—Automatic balances, Akron, Colo., July 24, 1912; boxes closed and recorders covered 132

PLATE X. Fig. 1.—Front of balance, cover removed, showing mechanism. Fig. 2.—General view of automatic balance with case removed 132

PLATE XI. Fig. 1.—Measuring tray used in counting total number of balls delivered to the container on the balance arm during the 24-hour period. Fig. 2.—Another view of the measuring tray looking vertically downward on the tray, showing the 60° angle which the base makes with the graduated side 132

ALTERNARIA PANAX, THE CAUSE OF A ROOT-ROT OF GINSENG

PLATE XII. Lesions on ginseng roots due to *Alternaria panax* .....

PLATE XIII. Fig. 1.—Longitudinal section of ginseng root showing the results of inoculation with *Alternaria panax*. Fig. 2.—Inoculations on ginseng leaves with the species of Alternaria isolated from ginseng roots 182

SOME POTATO TUBER-ROTS CAUSED BY SPECIES OF FUSARIUM

PLATE A (Colored). *Fusarium* spp. on vegetable media: Fig. 1–3 and 5.—*Fusarium oxysporum* Schlecht. 3045. 1, Twenty-one-day-old culture on potato cylinder showing typical bluish green sclerotial masses, no pionnotes. 2, Eighteen-day-old culture on stem of *Melilotus alba* with pionnotes. 3, Eighteen-day-old rice culture with typical coloration of the section Elegans. 5, Thirty-day-old cotton-stem culture with sporodochia. Fig. 4.—*F. hyperoxysporum* Wollenw. 3343. Thirty-one-day-old culture on potato cylinder with development of pionnotes. Fig. 6–8.—*F. radicicola* Wollenw. 6, Potato cylinder 34 days old with pionnotes brown to verdigris. 7, Seventeen-day-old culture on stem of *Melilotus alba* with pionnotes and immature sporodochia. 8, Rice 28 days old, with pionnotes on upper surface 210

PLATE B (Colored). *Fusarium* spp. on vegetable media: Fig. 1–3.—*Fusarium discolor* Appel and Wollenw. 153, showing typical color reactions of this type species of the section Discolor. 1, Potato cylinder 11 days old, showing carmine-red pigmentation of the plectenchymatic mycelium. 2, Culture on cotton stem 35 days old, showing sporodochia and pionnotes drying out. 3, Rice culture 11 days old. Fig. 4–6.—*F. discolor*, var. *sulphureum* (Schlecht.) Appel and Wollenw., 154. 4, Ocherous-orange pionnotes on 11-day-old potato cylinder. 5, Sporodochia on 39-day-old cotton-stem culture. 6, Rice culture 11 days old 210

PLATE XIV. Fig. 1.—*Fusarium oxysporum* Schlecht. Fig. 2.—*F. radicicola* Wollenw. Fig. 3.—*F. solani* (Mart.) Sacc. Fig. 4.—*F. eumartii*, n. sp. Normal conidia. Fig. 5.—*F. coeruleum* (Lib.) Sacc. Fig. 6.—*F. discolor*, var. *sulphureum* (Schlecht.) App. and Wollenw 210

PLATE XV. Fig. 1, 2.—Potato tuber showing a soft-rot caused by *Fusarium hyperoxysporum* Wollenw. Fig. 3.—Potato tuber showing the type of rot produced by *F. oxysporum* in the experiments. Fig. 4, 5.—Potato tuber showing a dry-rot caused by *F. radicicola* 210

PLATE XVI. Two "jelly-end" tubers from Moorland, Cal., showing external views and longitudinal sections 210

Page

PLATE XVII. "Jelly-end" rot produced by inoculation with *Fusarium radicicola* Wollenw.: Fig. 1, 2, 3.—Potato tuber inoculated with *F. radicicola* 2890. Fig. 4.—Control potato tuber..... 210

PLATE XVIII. Tuber-rot from Pennsylvania caused by *Fusarium eumartii*, n. sp.: Fig. 1, 2.—External and sectional view of the same potato tuber. Fig. 3, 4.—Sectional views of other potato tubers. Fig. 5.—A cross section of a potato tuber showing how the fungus frequently follows the tissue adjacent to the bundle ring..... 210

PLATE XIX. Tuber-rot produced in the laboratory with *Fusarium eumartii*, n. sp., and control potato tuber: Fig. 1, 2.—Control. Fig. 3.—Potato tubers showing a soft-rot as a result of rapid development. Fig. 4, 5.—Potato tubers selected to illustrate the type of rot in slower development..... 210

RELATION OF SULPHUR COMPOUNDS TO PLANT NUTRITION

PLATE XX. Fig. 1.—Clover plants, showing influence of sulphates on growth. Fig. 2.—Radish plants, showing influence of sulphates on growth. Fig. 3.—Radish plants, showing influence of sulphates on growth..... 250

PLATE XXI. Red clover, showing effect of sulphates on growth of roots..... 250

PLATE XXII. Fig. 1.—Rape plants, showing influence of sulphates on growth. Fig. 2.—Barley plants, showing influence of sulphates on growth. Fig. 3.—Oat plants, showing influence of sulphates on growth..... 250

DISTRIBUTION OF THE VIRUS OF THE MOSAIC DISEASE IN CAPSULES, FILAMENTS, ANTHERS, AND PISTILS OF AFFECTED TOBACCO PLANTS

PLATE XXIII. Malformed blossoms of tobacco (*Nicotiana tabacum*) caused by the mosaic disease, which is often responsible for the various abnormalities shown..... 256

DISSEMINATION OF BACTERIAL WILT OF CUCURBITS

PLATE XXIV. Fig. 1.—Cucumber field No. 2, with beetle-proof cages in place. Fig. 2.—Field No. 1, with one of the cages lifted to show structure of the buried part..... 260

GOSSYPOL, THE TOXIC SUBSTANCE IN COTTONSEED MEAL

PLATE XXV. Gossypol glands of the cottonseed: Fig. 1.—Lengthwise sections of cottonseed kernels, showing glands, folded cotyledons, and hypocotyl. Fig. 2.—Cross sections of five widely different varieties of cottonseed kernels: *a*, Russell Big Boll; *b*, Willet's Red Leaf; *c*, Piedmont Long-Staple; *d*, Allen's Early; *e*, Wine Sap..... 288

PLATE XXVI. Fig. 1.—Crystals of gossypol "acetate" from alcohol and 50 per cent acetic acid. Fig. 2.—Crystals of gossypol from acetone..... 288

TWO NEW HOSTS FOR PERIDERMIUM PYRIFORME

PLATE XXVII. Fig. 1.—*Peridermium pyriforme* on a trunk of *Pinus divaricata*, showing the form of the peridia before they are ruptured to allow the escape of the æciospores. Fig. 2.—A globose gall with *Peridermium pyriforme* on a trunk of *Pinus contorta*, associated with two lesions of *Peridermium comptoniae*, one near the gall and the other 1 inch above it at the base of a branch. Fig. 3.—*Peridermium pyriforme* on a branch of *Pinus arizonica* showing unopened peridia..... 290

PATHOGENICITY AND IDENTITY OF SCLEROTINIA LIBERTIANA AND SCLEROTINIA SMILACINA ON GINSENG

Page

PLATE XXVIII. *Sclerotinia libertiana:* Fig. 1.—Root inoculated with *Sclerotinia libertiana* from lettuce. Fig. 2.—Three roots (on left) inoculated with *Sclerotinia* sp. from ginseng. Healthy check root (on right). Fig. 3.—Apothecia from sclerotia from celery strain. Fig. 4.—Apothecia from sclerotia from ginseng strain 298

PLATE XXIX. *Sclerotinia smilacina:* Fig. 1.—Ginseng roots showing the characteristic black color from artificial inoculation. Fig. 2.—Rhizomes of *Smilacina racemosa* inoculated with a species of Sclerotinia isolated from ginseng 298

AN IMPROVED RESPIRATION CALORIMETER FOR USE IN EXPERIMENTS WITH MAN

PLATE XXX. General view of the respiration calorimeter 348

PLATE XXXI. Fig. 1.—Structural iron framework for respiration chamber. Fig. 2.—Copper-walled chamber attached to inside of iron framework 348

PLATE XXXII. Fig. 1.—Zinc wall attached to outside of iron framework, with all but the last sections shown in place. Fig. 2.—Devices for circulating and purifying air 348

PLATE XXXIII. Fig. 1.—Special container for sulphuric acid, to remove water vapor from air passing through it. Fig. 2.—A small absorber train for removing water vapor and carbon dioxid from sample of residual air ... 348

PLATE XXXIV. Fig. 1.—Balance for weighing oxygen cylinder and end view of absorber table. Fig. 2.—Method of attaching heating and cooling systems to zinc wall 348

PLATE XXXV. Fig. 1.—Interior of respiration chamber with subject as seen through the window. Fig. 2.—Apparatus for regulating and measuring the temperature of water 348

PLATE XXXVI. Fig. 1.—Observer's table. Fig. 2.—Devices for regulating temperature of water for heat absorber 348

VARIETAL RESISTANCE OF PLUMS TO BROWN-ROT

PLATE XXXVII. Fig. 1.—Lenticel in ripe fruit of Sapa plum. Fig. 2.—Lenticel in ripe fruit of Gold plum partially filled with parenchymatous cells. Fig. 3.—Lenticel in green Burbank plum. Fig. 4.—Lenticel in green fruit of B × W21 completely filled with parenchymatous tissue. Fig. 5.—Ripe healthy tissue of Sapa plum, showing middle lamella completely dissolved out, owing to ripening process. Fig. 6.—Ripe healthy tissue of Reagan plum two weeks after picking 396

PLATE XXXVIII. Fig. 1.—Infection through a lenticel of Burbank plum the cavity of which is lined with corky-walled cells. Fig. 2.—Left side of figure 1 in detail, showing hyphæ entering the fruit tissue after the epidermis has been raised by the growth of the hyphæ in the stomatal cavity. Fig. 3.—Infection through a lenticel in B × W4. Fig. 4.—Infection through a stoma in a young green fruit of *Prunus americana* seedling No. 1, in which no corky walls have yet been formed. Fig. 5.—Infection through a lenticel of the same type as is shown in figures 1 and 3. Fig. 6.—Half-grown fruits of B × W15 completely rotted through wound inoculations. Fig. 7.—Half-grown fruits of B × W21 completely rotted through wound inoculations. Fig. 8.—Half-grown fruits of A × W15 completely rotted through wound inoculations. Fig. 9.—Half-grown fruits of Etopa plum completely rotted through wound inoculations, and completely covered with large spore tufts 396

Page

PLATE XXXIX. Fig. 1.—A rotting area in an overripe fruit of S. D. No. 3. Fig. 2.—Tip of hypha in Opata plum. Fig. 3.—The edge of a rotting spot in a green fruit of Opata plum. Fig. 4.—Tissue of apple infected with *Penicillium expansum*. Fig. 5.—Cross sections of hyphæ in tissue of Opata plum 18 hours after inoculation. Fig. 6.—Portion of the rotted area of an Opata plum 18 hours after inoculation 396

INHERITANCE OF LENGTH OF POD IN CERTAIN CROSSES

PLATE XL. Typical 5-seeded bean pods, showing the length of parents and crosses 420

A HONEYCOMB HEART-ROT OF OAKS CAUSED BY STEREUM SUBPILEATUM

PLATE XLI. Fig. 1.—*Quercus alba:* A radial view of the honeycomb heart-rot produced by *Stereum subpileatum*, showing various stages of the rot. Fig. 2.—*Quercus alba:* A radial view of the last (honeycomb) stage of the rot. Fig. 3.—*Quercus alba:* A tangential view of honeycomb-rot, showing early stage of delignification. Fig. 4.—*Quercus velutina:* A radial view of honeycomb heart-rot as it occurs in tops of trees, showing pockets filled with strands of cellulose. Fig. 5.—*Quercus alba:* A radial view of the honeycomb-rot, showing pockets lined with cellulose. Fig. 6.—*Quercus alba:* A cross-sectional view of the honeycomb heart-rot, showing pockets limited by large medullary rays. Fig. 7.—*Quercus alba:* Radial view of honeycomb heart-rot in branch, showing last stage of rot. Fig. 8.—*Quercus lyrata:* Radial view of honeycomb heart-rot in old log associated directly with the sporophores of *S. subpileatum*. Fig. 9.—*Quercus texana:* Sporophore of *S. subpileatum*. Fig. 10.—*Quercus palustris:* Sporophore of *S. subpileatum*, conchate form 428

INFLUENCE OF GROWTH OF COWPEAS UPON SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL PROPERTIES

PLATE XLII. Experimental plots at Missouri Experiment Station: Fig. 1.—Plot D (right), unplowed, no crop, kept clean; plot E (center), unplowed, planted to cowpeas; plot F (left), plowed, planted to cowpeas. Fig. 2.—Plot G (right), plowed, no crop, artificially shaded; plot H (left), plowed, no crop, kept clean 448

ANGULAR LEAF-SPOT OF CUCUMBERS

PLATE XLIII. Fig. 1.—Cucumber leaf eight days after inoculation with *Bacterium lachrymans*. Fig. 2.—Cucumber leaf 12 days after spraying with *Bact. lachrymans* 476

PLATE XLIV. Cucumber stem diseased by *Bacterium lachrymans* 476

PLATE XLV. Fig. 1.—Fragment of a cucumber leaf showing angular leaf-spots due to pure-culture inoculation with *Bacterium lachrymans*. Fig. 2.—Cucumber plant 18 days after spraying with *Bact. lachrymans*. Fig. 3.—Stem at X in figure 2 enlarged to show bacterial lesions 476

PLATE XLVI. Green cucumber fruit photographed six days after inoculation with *Bacterium lachrymans*. Fig. 2.—Same fruit as shown in figure 1, but at the end of 12 days. Fig. 3.—Section of green cucumber fruit 10 days after inoculation with *Bact. lachrymans* 476

PLATE XLVII. Fig. 1.—Cross section of a cucumber leaf, showing two stomatal infections. Fig. 2.—Cross section of cucumber leaf, showing a dense bacterial infection due to *Bacterium lachrymans*. Fig. 3.—*A*, Agar-poured plate from bouillon dilution of *Bact. lachrymans; B*, agar-poured plate made from same quantity of same bouillon as *A*, but after freezing 15 minutes.. 476

Page

PLATE XLVIII. Fig. 1.—Chains of *Bacterium lachrymans* from 14-day-old culture in salted bouillon. Fig. 2.—Capsules of *Bact. lachrymans* from young agar culture. Fig. 3.—Flagella of *Bact. lachrymans* from 24-hour-old agar slant..... 476

PLATE XLIX. Fig. 1.—Young surface colonies of *Bacterium lachrymans* on agar poured plate, showing opaque center and lines radiating into the thinner margin. Fig. 2.—Surface colonies of *Bact. lachrymans* on gelatin poured plate. Fig. 3.—Gelatin stab culture of *Bact. lachrymans*, kept at 20° C. and photographed at the end of 12 days..... 476

BIOLOGY OF APANTELES MILITARIS

PLATE L. *Apanteles militaris:* Fig. 1.—Diagrammatic drawing showing the embryo inclosed by the fused amniotic and serosal envelopes. Fig. 2.—Diagrammatic drawing showing the fused envelopes dividing into their two parts, the serosal cells being grouped at each pole. Fig. 3.—Diagrammatic drawing showing the egg ready to hatch, the serosal cells having become a loose mass and the embryo straightened out in the egg. Fig. 4.—Diagrammatic drawing of the larva during its first molt. Fig. 5.—First instar. Fig. 6.—Second instar. Fig. 7.—Third instar, showing the position of the spiracles and the caudal vesicle withdrawn..... 508

CHERRY AND HAWTHORN SAWFLY LEAF MINER

PLATE LI. Fig. 1.—Leaves of English Morello cherry, showing injury by the sawfly leaf miner. Fig. 2.—Leaves of hawthorn, showing injury by the sawfly leaf miner..... 528

PETROGRAPHY OF SOME NORTH CAROLINA SOILS AND ITS RELATION TO THEIR FERTILIZER REQUIREMENTS

PLATE LII. Fig. 1.—Photomicrograph of Porters soil of the Appalachian, No. 5 sand. Fig. 2.—Photomicrograph of Cecil soil of the Piedmont Plateau, No. 5 sand..... 582

HOURLY TRANSPIRATION RATE ON CLEAR DAYS AS DETERMINED BY CYCLIC ENVIRONMENTAL FACTORS

PLATE LIII. General view of the water requirement and transpiration experiments at Akron, Colo., on July 8, 1913..... 650

PLATE LIV. Fig. 1.—Wheat on automatic balances in the screened inclosure, July 3, 1912, showing the exposure and arrangement of the 1912 experiments. Fig. 2.—Automatic balances A, B, and C; A and C carry pots of cowpeas and B carries the evaporation tank..... 650

PLATE LV. Fig. 1.—A pot of alfalfa showing the growth and size of plants used in the transpiration experiments. Fig. 2.—A pot of *Amaranthus retroflexus* of the type used in the transpiration measurements. Fig. 3.—Evaporation tank mounted on automatic balance..... 650

EFFECT OF ELEMENTAL SULPHUR AND OF CALCIUM SULPHATE ON CERTAIN OF THE HIGHER AND LOWER FORMS OF PLANT LIFE

PLATE LVI. Fig. 1.—Red-clover plants, showing the effect of treatment with calcium sulphate. Fig. 2.—Group *A*, untreated; *B*, 0.1 per cent of calcium sulphate added to Miami silt-loam soil; *C*, 0.02 per cent added; *D*, 0.05 per cent added; *E*, 0.1 per cent added..... 780

SWEET-POTATO SCURF

Page

PLATE LVII. A sweet potato showing the discoloration produced by *Monilochaetes infuscans*..... 792

PLATE LVIII. *Monilochaetes infuscans: A*, a branched conidiophore with conidia attached. *B*, an unbranched conidiophore, showing septation; conidium attached. *C*, a conidiophore from host, with conidium attached. *D*, a conidiophore from the host, showing the peculiar basal cell and septation. *E*, a conidiophore bearing conidium, showing diagrammatically the attachment to the host by a bulblike enlargement of the basal cell. *F*, two conidiophores joined at the base and slightly sunken in the tissue of the host. *G*, two conidiophores joined by a single oblong cell. *H*, two conidiophores joined at the base and slightly sunken in the tissue of the host. *I*, a conidiophore from the host with an almost spherical cell attached to the enlarged end cell. *J*, a conidiophore, showing an attachment of two almost round cells to the enlarged basal cell. *K*, germination and growth of conidia in a sweet-potato decoction in 24 hours. *L*, hyphæ from a culture, showing characteristic branching and septation. *M*, a group of mature conidia. *N*, germination, growth, branching, and septation of the fungus at the end of 42 hours in a sweet-potato decoction..... 792

BANANA AS A HOST FRUIT OF THE MEDITERRANEAN FRUIT FLY

PLATE LIX. Fig. 1.—Popoulu variety of cooking banana found infested with the Mediterranean fruit fly. Fig. 2.—Cross section of the Moa variety of cooking banana, showing pulp infested by larvæ of the Mediterranean fruit fly..... 804

PLATE LX. Fig. 1.—A bunch of Chinese bananas (*Musa cavendishii*). Fig. 2.—A bunch of Chinese bananas wrapped in banana leaves and ready for shipment to California..... 804

PLATE LXI. Fig. 1.—Cleaning bananas in Hawaii before shipment. Fig. 2.—Tip of Chinese banana (*Musa cavendishii*), showing punctures made by the female Mediterranean fruit fly in attempts to deposit eggs within the peel. 804

PLATE LXII. Fig. 1.—Rearing cage erected over 20 Chinese banana trees and inclosing 14 bunches in various stages of development. Fig. 2.—Interior of rearing cage shown in figure 1..... 804

LIFE-HISTORY STUDIES OF THE COLORADO POTATO BEETLE

PLATE LXIII. Colorado potato beetle (*Liptinotarsa decemlineata*): Fig. 1.—Egg mass. Fig. 2.—Young larva..... 926

OBSERVATIONS ON THE LIFE HISTORY OF THE CHERRY LEAF BEETLE

PLATE LXIV. *Galerucella cavicollis:* Fig. 1.—Adult. Fig. 2.—Larva, second instar. Fig. 3.—Larva, third instar. Fig. 4.—Pupa..... 950

PLATE LXV. *Galerucella cavicollis:* Fig. 1.—Eggs on ground at base of tree. Fig. 2.—Eggs, enlarged. Fig. 3.—Larvæ feeding on leaf. Fig. 4.—Work of larvæ on foliage. Fig. 5.—Work of beetles on foliage..... 950

APPARATUS FOR MEASURING THE WEAR OF CONCRETE ROADS

PLATE LXVI. Fig. 1.—Instrument for measuring wear of roads in use on concrete road. Fig. 2.—Photograph of details of instrument..... 954

MORPHOLOGY AND BIOLOGY OF THE GREEN APPLE APHIS

PLATE LXVII. Forms of *Aphis pomi:* Fig. 1.—Winged viviparous female. Fig. 2.—Male. Fig. 3.—Pupa. Fig. 4.—Oviparous female. Fig. 5.—Wingless viviparous female. Fig. 6.—Intermediate..... 994

Page

PLATE LXVIII. Embryology of *Aphis pomi:* Fig. 1.—Fertilized egg previous to formation of blastoderm. Fig. 2.—Fertilized egg showing formation of blastoderm. Fig. 3.—Unfertilized egg. Fig. 4.—Polar organ. Fig. 5.—Conditions of embryo and polar organ at commencement of revolution. Fig. 6.—Yolk cell. Fig. 7.—Germ cell..... 994

PLATE LXIX. Embryology of *Aphis pomi:* Fig. 1.—Ovarian yolk before division. Fig. 2.—Half of ovarian yolk shortly after "dumb-bell" formation. 994

PLATE LXX. Embryology of *Aphis pomi:* Fig. 1.—Half of ovarian yolk, end chambers forming. Fig. 2.—Half of ovarian yolk, end chambers formed.. 994

PLATE LXXI. Embryology of *Aphis pomi:* Fig. 1.—Half of ovarian yolk, egg chambers forming. Fig. 2.—Thickening serosa accompanied by cells of polar organ..... 994

PLATE LXXII. Embryology of *Aphis pomi:* Fig. 1.—Invagination of dorsal body. Fig. 2.—Dorsal body completely formed..... 994

PLATE LXXIII. Embryology of *Aphis pomi:* Emerging nymph, showing egg burster..... 994

PLATE LXXIV. Structural details of *Aphis pomi*, *A. avenae*, and *A. malifoliae:* Fig. 1.—*Aphis pomi:* Antenna of wingless viviparous female, adult. Fig. 2.—*A. pomi:* Antenna of wingless viviparous female, third instar. Fig. 3.—*A. pomi:* Antenna of wingless viviparous female, second instar. Fig. 4.—*A. pomi:* Antenna of wingless viviparous female, first instar. Fig. 5.—*A. pomi:* Antenna of stem mother. Fig. 6.—*A. pomi:* Antenna of intermediate. Fig. 7.—*A. pomi:* Antenna of winged viviparous female. Fig. 8.—*A. pomi:* Male genitalia. Fig. 9.—*A. pomi:* Antenna of male. Fig. 10.—*A. pomi:* Antenna of wingless viviparous female, fourth instar. Fig. 11.—*A. pomi:* Cornicle of winged viviparous female. Fig. 12.—*A. pomi:* Cornicle of wingless viviparous female. Fig. 13.—*A. pomi:* Cornicle of male. Fig. 14.—*A. pomi:* Cornicle of oviparous female. Fig. 15.—*A. avenae:* Antenna of stem mother, first instar. Fig. 16.—*A. pomi:* Antenna of stem mother, first instar. Fig. 17.—*A. malifoliae:* Cornicle of winged viviparous female. Fig. 18.—*A. avenae:* Cornicle of winged viviparous female. Fig. 19.—*A. pomi:* Cauda of adult. Fig. 20.—*A. pomi:* Hind tibia of oviparous female. Fig. 21.—*A. pomi:* Cauda of pupa..... 994

PLATE LXXV. *Aphis pomi* on its host plant: Fig. 1.—Colonies on apple. Fig. 2.—Apple twig bearing eggs..... 994

SOILSTAIN, OR SCURF, OF THE SWEET POTATO

PLATE LXXVI. Fig. 1.—Petri dish containing a pure culture of *Monilochaetes infuscans*. Fig. 2.—*a*, Part of a conidiophore of *M. infuscans*, showing the unbroken chain of conidia; *b*, *d*, and *k*, various ways of the breaking up of the chains of conidia when disturbed or moistened; *c*, *e*, *f*, *g*, *h*, and *j*, spores collecting in pockets after the chains of conidia have broken up; *i*, bending in of the chain of conidia prior to breaking up into individual spores..... 1002

PLATE LXXVII. *a*, Part of a cross section of a sweet-potato root, showing the relationship of *Monilochaetes infuscans* to the epidermis of the host; *b*, germination of a fragment of mycelium of *M. infuscans*, showing the germ tube which is first produced and upon which conidia are borne; *c*, *d*, *e*, *f*, *g*, *h*, *i*, and *t*, different stages in the development of the spore and the chain of conidia; *o*, *j*, *k*, and *p*, protruding hyaline tube at the tip of the conidiophore on which are borne the conidia; *l*, *n*, and *w*, differentiation of the coarser dark mycelium, and the finer hyaline to subhyaline hyphæ; *u*, attachment of the conidiophore to the mycelium; *r*, conidiophore-bearing mycelium, being part of *u*; *m*, *q*, *s*, *v*, *x*, *y*, and *z*, different stages in the germination of the conidia of *M. infuscans*..... 1002

AN ASIATIC SPECIES OF GYMNOSPORANGIUM ESTABLISHED IN OREGON

Page

PLATE LXXVIII. Fig. 1.—Æcial stage of *Gymnosporangium koreaense* on under surface of leaf of *Pyrus sinensis*. Fig. 2.—Telial stage of *G. koreaense* on young twigs of *Juniperus chinensis;* sori not distended. Fig. 3.—Same as figure 2, with sori distended 1010

PLATE LXXIX. Fig. 1.—*Gymnosporangium koreaense* on leaves, petioles, and stems of *Pyrus sinensis*. Fig. 2.—*G. koreaense* on *Cydonia vulgaris* 1010

RELATION OF STOMATAL MOVEMENT TO INFECTION BY CERCOSPORA BETICOLA

PLATE LXXX. Fig. 1.—Stomatoscope designed by Dr. F. E. Lloyd and used for a part of these studies. Fig. 2.—Humidity box in place over plants in the greenhouse for maintaining different relative humidities; also a cog psychrometer used for checking hygrothermographs kept among the sugar-beet plants 1038

PLATE LXXXI. *Cercospora beticola* Sacc: Conidia germinating on a sugar-beet leaf, with germ tubes entering open stomata 1038

A NEW PENETRATION NEEDLE FOR USE IN TESTING BITUMINOUS MATERIALS

PLATE LXXXII. Fig. 1.—Direct enlargement of a package of No. 2 sewing needles, showing the variations in shape. Fig. 2.—Direct enlargement of penetration needles, showing the comparison between two standard needles and seven needles of the new type prepared by the writers 1126

RELATION OF GREEN MANURES TO THE FAILURE OF CERTAIN SEEDLINGS

PLATE LXXXIII. Cotton seedlings, showing the effect of green manures on their growth: Fig. 1.—Effect of different kinds of green manures added to the soil. Fig. 2.—Effect of planting immediately after plowing under green manure. Fig. 3.—Effect of planting 2 weeks after plowing under green manure. Fig. 4.—Effect of the depth of green manure on germination. Fig. 5.—Effect of sterilized and unsterilized oats used as a green manure. Fig. 6.—Effect of *Rhizoctonia* sp. on germination in the presence of green manure 1176

PLATE LXXXIV. Clover, flax, and cotton seedlings, showing the relation of green manures to germination in sterilized and unsterilized soil: Fig. 1, 2.—Clover. Fig. 3, 4.—Flax. Fig. 5, 6.—Cotton 1176

A NEW SPRAY NOZZLE

PLATE LXXXV. The beginning of the spray from three kinds of nozzles, as photographed with a moving-picture camera 1182

PLATE LXXXVI. Fig. 1.—The appearance of spray from three kinds of nozzles as full pressure is applied (a continuation of Plate LXXXV). Fig. 2.—Two stages at the end of the spray as the pressure is reduced 1182

27468°—16——2

TEXT FIGURES

Effect of Alkali Salts in Soils on the Germination and Growth of Crops

Page

FIG. 1. Diagram showing percentage of salts, mixtures, and their position in the diagrams of experimental sets 12

2. Diagram showing the number of wheat plants up and dry matter produced in 24 days on Greenville loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 15

3. Diagram showing the number of wheat plants up and dry matter produced in 24 days on Greenville loam with calcium chlorid, magnesium chlorid, and potassium chlorid in different combinations and concentrations 16

4. Diagram showing the number of wheat plants up and dry matter produced in 24 days on Greenville loam with potassium nitrate, magnesium nitrate, and sodium nitrate in different combinations and concentrations 16

5. Diagram showing the number of wheat plants up and dry matter produced in 24 days on Greenville loam with potassium sulphate, magnesium sulphate, and sodium sulphate in different combinations and concentrations 17

6. Diagram showing the number of wheat plants up and dry matter produced in 24 days on Greenville loan with ammonium carbonate, sodium carbonate, and potassium carbonate in different combinations and concentrations 17

7. Diagram showing the number of wheat plants up and dry matter produced in 14 days on coarse sand with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 18

8. Diagram showing the number of wheat plants up and dry matter produced in 14 days on coarse sand with calcium chlorid, magnesium chlorid, and potassium chlorid in different combinations and concentrations 18

9. Diagram showing the number of wheat plants up and dry matter produced in 14 days on coarse sand with potassium nitrate, magnesium nitrate, and sodium nitrate in different combinations and concentrations 19

10. Diagram showing the number of wheat plants up and dry matter produced in 14 days on coarse sand with potassium sulphate, magnesium sulphate, and sodium sulphate in different combinations and concentrations 19

11. Diagram showing the number of wheat plants up and dry matter produced in 14 days on coarse sand with ammonium carbonate, sodium carbonate, and potassium carbonate in different combinations and concentrations 20

12. Diagram showing the number of wheat plants up and dry matter produced in 16 days on College loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 20

13. Diagram showing the number of wheat plants up and dry matter produced in 16 days on College loam with calcium chlorid, magnesium chlorid, and potassium chlorid in different combinations and concentrations 21

Page

FIG. 14. Diagram showing the number of wheat plants up and dry matter produced in 16 days on College loam with potassium nitrate, magnesium nitrate, and sodium nitrate in different combinations and concentrations 21

15. Diagram showing the number of wheat plants up and dry matter produced in 16 days on College loam with potassium sulphate, magnesium sulphate, and sodium sulphate in different combinations and concentrations 22

16. Diagram showing the number of corn plants up and dry matter produced in 21 days on Greenville loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 22

17. Diagram showing the number of barley plants up and dry matter produced in 24 days on Greenville loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 23

18. Diagram showing the number of wheat plants up and dry matter produced in 16 days on College loam with ammonium carbonate, sodium carbonate, and potassium carbonate in different combinations and concentrations 23

19. Diagram showing the number of oat plants up and dry matter produced in 21 days on Greenville loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations. 24

20. Diagram showing the number of sugar-beet plants up and dry matter produced in 21 days on Greenville loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 24

21. Diagram showing the number of alfalfa plants up and dry matter produced in 21 days on College loam with sodium sulphate, sodium carbonate, and sodium chlorid in different combinations and concentrations 25

22. Diagram showing the number of Canada field-pea plants up and dry matter produced in 21 days on Greenville loam with sodium chlorid, sodium sulphate, and sodium carbonate in different combinations and concentrations 25

23. Diagram showing the number of seedlings alive and dry matter produced in tops and roots in 21 days with solutions of sodium chlorid, sodium sulphate, and sodium carbonate in different combinations and concentrations 26

24. Diagram showing the number of wheat seedlings alive and dry matter produced in tops and roots in 21 days with solutions of potassium chlorid, calcium chlorid, and magnesium chlorid in different combinations and concentrations 27

25. Diagram showing the number of wheat seedlings alive and dry matter produced in tops and roots in 21 days with solutions of sodium nitrate, potassium nitrate, and magnesium nitrate in different combinations and concentrations 27

26. Curve showing the number of wheat plants germinating in College loam, Greenville loam, and sand with different concentrations 29

27. Curve showing the number of wheat plants germinating in College loam, Greenville loam, and sand containing various salts 30

28. Curve showing the effect of various combinations of salts in different concentrations on the number of wheat plants germinating 30

Page

FIG. 29. Curve showing the effect of concentration of salts on the number of seeds of various kinds germinating 31
30. Curve showing the effect of sodium chlorid, sodium carbonate, and sodium sulphate on the number of plants up from seeds of various kinds 32
31. Curve showing the dry weight of wheat plants germinating in College loam, Greenville loam, and sand with different concentrations 32
32. Curve showing the dry weight of wheat plants germinating in College loam, Greenville loam, and sand containing various salts 33
33. Curve showing the effect of various combinations of salts in different concentrations on the amount of dry weight produced 33
34. Curve showing the effect of concentration of salts on the dry weight of plants from seeds of various kinds 34
35. Curve showing the effect of soduim chlorid, sodium carbonate, and sodium sulphate on the dry weight from seeds of various kinds 35
36. Curve showing the number of days for wheat plants to come up in College loam, Greenville loam, and sand with different concentrations .. 36
37. Curve showing the number of days for wheat plants to come up in College loam, Greenville loam, and sand containing various salts 37
38. Curve showing the effect of various combinations of salts in different concentrations on the number of days to come up 38
39. Curve showing the effect of concentration of salts on the number of days to come up from seeds of various kinds 38
40. Curve showing the effect of sodium chlorid, sodium carbonate, and sodium sulphate on the number of days to come up from seeds of various kinds 39
41. Curve showing the height of wheat plants germinating in College loam, Greenville loam, and sand with different concentrations 39
42. Curve showing the height of wheat plants germinating in College loam, Greenville loam, and sand containing various salts 40
43. Curve showing the effect of various combinations of salts in different concentrations on the height of plants 40
44. Curve showing the effect of concentration of salts on the height of plants from seeds of various kinds 41
45. Curve showing the effect of sodium chlorid, sodium carbonate, and sodium sulphate on the height of plants from seeds of various kinds .. 41
46. Diagram showing the percentage of alkali salt in loam soil giving about half normal germination and production of dry matter in wheat 49
47. Diagram showing the percentage of alkali salt in coarse sand giving about half normal germination and production of dry matter in wheat 50
48. Curve showing the percentage of sodium chlorid, sodium carbonate, and sodium sulphate in Greenville loam giving about half normal germination and production of dry matter 51

PERENNIAL MYCELIUM IN SPECIES OF PERONOSPORACEAE RELATED TO PHYTOPHTHORA INFESTANS

FIG. 1. A cross section of a stem of *Helianthus divaricatus* which is infected with *Plasmopara halstedii* 65

HIBERNATION OF PHYTOPHTHORA INFESTANS IN THE IRISH POTATO

FIG. 1. Cross section of a potato plant, showing the mycelium of *Phytophthora infestans*, which has killed the cells of the cortex and is a later stage than that shown in figure 3 89

Page

FIG. 2. A portion of the same section of a potato plant shown in figure 1, showing the mycelium in the pith region of the stem 90
3. A cross section of the cortical region of a potato stem, showing the mycelium of *Phytophthora infestans* 91

AN AUTOMATIC TRANSPIRATION SCALE OF LARGE CAPACITY FOR USE WITH FREELY EXPOSED PLANTS

FIG. 1. Vesque's automatic balance for measuring transpiration 118
2. Anderson's apparatus for measuring transpiration 118
3. Ganong's automatic transpirometer 119
4. Woods's adaptation of Marvin's weighing rain gage as a transpiration balance 120
5. The Marvin register used by Woods for recording transpiration 120
6. Schematic diagram of Blackman and Paine's recording transpirometer 121
7. Krutizky's potometer for recording transpiration 121
8. The transpiration balance of Richard Frères with its recording apparatus 122
9. Copeland's apparatus for recording transpiration 123
10. Corbett's apparatus for measuring transpiration 124
11. View of the beam and auxiliary equipment of the platform transpiration scale designed to carry large pots of plants weighing 150 kgm. or more 125
12. Details of the ball-dropping mechanism 126
13. Dashpot for preventing the oscillation of the beam during windy weather 127
14. Spring motor, showing the cam K for raising the beam, and the fan F for regulating the speed 127
15. Another view of the spring motor, showing the control mechanism ... 128
16. Sample records from the automatic transpiration scale 129
17. Wiring diagram of the electric circuits of the automatic transpiration scale 130
18. Transpiration graphs corresponding to the three records given in figure 16, plotted in rectangular coordinates 131

EFFECT OF TEMPERATURE ON MOVEMENT OF WATER VAPOR AND CAPILLARY MOISTURE IN SOILS

FIG. 1. Apparatus for determining thermal translocation of soil moisture when the column of soil lay horizontally 142
2. Apparatus for determining thermal translocation of soil moisture when the column of soil stood vertically 143
3. Curve showing the movement of moisture from a warm to a cold column of soil of uniform moisture content 146
4. Diagram illustrating the cause and mechanism of moisture movement from a warm to a cold column of soil of uniform moisture content ... 151
5. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of quartz sand, and from a moist and cold to a dry and warm column of quartz sand 162
6. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of Miami sandy loam, and from a moist and cold to a dry and warm column of Miami sandy loam 162
7. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of heavy sandy loam, and from a moist and cold to a dry and warm column of heavy sandy loam 163

Page

FIG. 8. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of Miami silt loam, and from a moist and cold to a dry and warm column of Miami silt loam..... 164
9. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of Clyde silt loam, and from a moist and cold to a dry and warm column of Clyde silt loam..... 165
10. Curve showing the percentage of moisture moved from a moist and warm column to a dry and cold column of Miami clay, and from a moist and cold to a dry and warm column of Miami clay..... 166
11. Curve showing the evaporation of water from Takoma soil fed with tap water: *A*, Soil under humid conditions; *B*, soil under arid conditions; *C*, water under arid conditions; *D*, water under humid conditions..... 170

SOIL TEMPERATURES AS INFLUENCED BY CULTURAL METHODS

FIG. 1. Typical charts of soil temperatures during the winter season..... 178
2. Typical charts of soil temperatures during the spring time..... 178
3. Typical charts of soil temperatures during the summer months..... 179
4. Typical charts of soil temperatures during the fall of the year..... 179

PATHOGENICITY AND IDENTITY OF SCLEROTINIA LIBERTIANA AND SCLEROTINIA SMILACINA ON GINSENG

FIG. 1. *Sclerotinia libertiana: A*, Camera-lucida drawing showing branched and unbranched paraphyses, asci, and ascospores; *B*, camera-lucida drawing showing methods of ascospore germination..... 294

INFLUENCE OF GROWTH OF COWPEAS UPON SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL PROPERTIES OF SOIL

FIG. 1. Soil-shading device, showing construction..... 441
2. Device for testing the compactness of the soil..... 442

BIOLOGY OF APANTELES MILITARIS

FIG. 1. *Apanteles militaris: A*, *B*, *C*, Diagrammatic sectional views of the posterior end of the embryo, showing how the hypertrophied cells of the hind gut, which ultimately form the caudal vesicle, grow out through the anus. *D* shows an external view of this process..... 497

HOURLY TRANSPIRATION RATE ON CLEAR DAYS AS DETERMINED BY CYCLIC ENVIRONMENTAL FACTORS

FIG. 1. Curve showing the comparison of the readings of the differential telethermograph with those of Abbot's silver-disk pyrheliometer... 585
2. Composite transpiration graph of wheat and environmental graphs for corresponding period..... 591
3. Composite transpiration graphs for the three varieties of wheat from which the composite graph of figure 2 was obtained..... 592
4. Composite transpiration graph for oats, with environmental graphs for corresponding periods..... 593
5. Composite transpiration graph of sorghum, with environmental graphs for corresponding period..... 601
6. Composite transpiration graph of rye, with environmental graphs and evaporation graph for corresponding period..... 603
7. Composite transpiration graph of alfalfa, with environmental graphs and evaporation graph for corresponding period..... 617

Page

FIG. 8. Composite transpiration graph for *Amaranthus retroflexus*, with environmental graphs and evaporation graph for corresponding period 619
9. Graphs showing transpiration of wheat and the hourly values of cyclic environmental factors, all plotted in percentage of the maximum or maximum range 628
10. Graphs showing the hourly transpiration of oats and the hourly values of the cyclic environmental factors, all plotted in percentage of the maximum or maximum range 628
11. Graphs showing the hourly transpiration of sorghum and the hourly values of cyclic environmental factors, all plotted in percentage of the maximum or maximum range 628
12. Graphs showing hourly transpiration of spring rye and the hourly values of the cyclic environmental factors, all plotted in percentage of the maximum or maximum range 629
13. Graphs showing the hourly transpiration of alfalfa and the hourly values of cyclic environmental factors, all plotted in percentage of the maximum or maximum range 629
14. Graphs showing the hourly transpiration of *Amaranthus retroflexus* and the hourly values of the cyclic environmental factors, all plotted in percentage of the maximum or maximum range 630
15. Graphs showing the hourly transpiration values of alfalfa for short periods in June and in October, with the hourly values of the cyclic environmental factors, all plotted in percentage of the maximum or maximum range 631
16. Comparison of the form of transpiration graphs with the graphs representing the total radiation and the vertical component of the radiation 632
17. Comparison of the transpiration graphs plotted in percentage of the maximum with the temperature graphs plotted in percentage of the maximum range 633
18. Comparison of transpiration with wet-bulb depression, both plotted in percentage of the maximum range 634
19. Comparison of the transpiration with the evaporation from a free-water surface in a shallow, blackened tank, both plotted in percentage of the maximum range 635
20. Graphs showing hourly ratio of transpiration to evaporation as plotted in figure 19 636
21. Graphs showing the observed transpiration with that computed from vertical radiation and temperature and from vertical radiation and saturation deficit 643
22. Graphs showing the observed evaporation with that computed by least-square methods from the vertical component of radiation and the saturation deficit 644

BIOCHEMICAL COMPARISONS BETWEEN MATURE BEEF AND IMMATURE VEAL

FIG. 1. Experiment 14. Curve showing the quantity (in cubic centimeters) of *N*/5 nitrogen in 100 c. c. of digestion fluid, equivalent to approximately 5 gm. of meat 693
2. Experiment 20. Curve showing the quantity (in cubic centimeters) of *N*/5 nitrogen in 100 c. c. of digestion fluid, equivalent to approximately 5 gm. of meat 696

Page

FIG. 3. Experiment 28. Curve showing the quantity (in cubic centimeters) of *N*/5 nitrogen in 100 c. c. of digestion fluid, equivalent to approximately 5 gm. of meat or 30 gm. of skim milk..... 697
4. Experiment 32. Curve showing the quantity (in milligrams) of amino nitrogen in 10 c. c. of digestion fluid..... 702
5. Curve showing the rate of growth of cats on an immature-veal diet.... 706
6. Curve showing the rate of growth of newly born cats..... 707

RELATION BETWEEN THE PROPERTIES OF HARDNESS AND TOUGHNESS OF ROAD-BUILDING ROCK

FIG. 1. Curve showing the results of tests of about 3,000 samples of road-building rock..... 905

APPARATUS FOR MEASURING THE WEAR OF CONCRETE ROADS

FIG. 1. Details of instrument for measuring the wear of roads..... 953

MORPHOLOGY AND BIOLOGY OF THE GREEN APPLE APHIS

FIG. 1. Map showing the localities in the United States from which the Bureau of Entomology has actual records of the green apple aphis (*Aphis pomi*)..... 958
2. Diagram showing the overlapping generations of the green apple aphis.. 982
3. Diagram showing curves for percentage of experiments on the green apple aphis in which the sexes appeared..... 987
4. Genealogical diagram showing the forms and generations developing from one stem mother of the green apple aphis..... 990

RELATION OF STOMATAL MOVEMENT TO INFECTION BY CERCOSPORA BETICOLA

FIG. 1. Stomatal pore widths on heart, mature, and old leaves and cotyledons of the sugar beet in the field, together with temperatures and relative humidities taken among the plants..... 1018
2. Stomatal pore widths on mature leaves kept under different relative humidities in a humidity box and free in the greenhouse..... 1024
3. Stomatal pore widths on mature leaves kept under different relative humidities in a humidity box and free in the greenhouse..... 1025
4. Stomatal pore widths on mature leaves kept under different relative humidities in a humidity box and free in the greenhouse..... 1026
5. Stomatal pore widths on mature leaves kept under different relative humidities in a humidity box and free in the greenhouse..... 1027
6. *Cercospora beticola:* Conidia germinating on a sugar-beet leaf, but germ tubes not entering or being greatly attracted by closed stomata..... 1035

A METHOD OF CORRECTING FOR SOIL HETEROGENEITY IN VARIETY TESTS

FIG. 1. Diagram illustrating the method of obtaining the "calculated" yield.. 1042
2. Diagram showing the observed and corrected yield (in grams) of grain on each of Montgomery's wheat plots in 1908–9..... 1044
3. Diagram showing the observed, corrected, and calculated yield (in grams) of Montgomery's wheat plots in groups of four, taken from figure 2..... 1045
4. Diagram showing the yield of oats (in bushels per acre) on the 1915 variety-test field at Highmoor Farm (Monmouth, Me.)..... 1046

FLOW THROUGH WEIR NOTCHES WITH THIN EDGES AND FULL CONTRACTIONS

FIG.		Page
1.	Plan and sectional elevations of the Fort Collins hydraulic laboratory	1054
2.	Device used in referring elevations of the notch crest to the reading of the hook gauge	1056
3.	Ladder, platform, and datum rod used in calibration tanks	1058
4.	Curves showing the relation between discharges with constant heads through rectangular notches of different lengths and the lengths of the notches	1062
5.	Curve showing the relation between a in the equation $Q=aL-b$ and the heads on rectangular notches	1063
6.	Curve showing the relation between b in the equation $Q=aL-b$ and the heads on rectangular notches	1064
7.	Curves showing discharges through rectangular notches of different lengths	1068
8.	Curve showing relation of coefficients (C) to lengths of rectangular notches	1071
9.	Curve showing relation of n to length of rectangular notches	1072
10.	Curves showing discharges through Cipolletti weir notches of different lengths	1078
11.	Curve showing discharges through 2-foot rectangular and Cipolletti notches and 2-foot notches having 1 to 3 and 1 to 6 side slopes	1082
12.	Logarithmic diagram of discharges through 28° 4′, 30°, 60°, 90°, and 120° triangular notches	1084
13.	Curves showing discharges through circular weir notches	1089
14.	Curves showing effect of different end and bottom contractions upon discharges through 1-foot and 3-foot rectangular notches with heads of 0.6 and 1 foot	1092
15.	Curves showing the effect of different end and bottom contractions upon the discharges through 1-foot and 3-foot Cipolletti weir notches with heads of 0.6 and 1 foot	1093
16.	Curves showing the effect of different ratios of cross-sectional area of the weir box (A) to the area of the notch (a) upon discharges through a 1-foot rectangular notch with heads of 0.6 and 1 foot	1096
17.	Curves showing the side slopes required with different heads in order that the discharge through a 2-foot notch will be twice the discharge through a 1-foot notch	1100
18.	Curves showing the discharges through a 1-foot rectangular notch submerged to different depths	1103
19.	Curves showing the discharges through a 2-foot rectangular notch submerged to different depths	1104
20.	Curves showing the discharges through a 3-foot rectangular notch submerged to different depths	1104
21.	Graph showing the discharges through a 4-foot rectangular notch submerged to different depths	1105
22.	Curves showing the discharges through a 1-foot Cipolletti notch submerged to different depths	1106
23.	Curves showing the discharges through a 2-foot Cipolletti notch submerged to different depths	1107
24.	Curves showing the discharges through a 3-foot Cipolletti notch submerged to different depths	1108
25.	Curves showing the discharges through a 4-foot Cipolletti notch submerged to different depths	1109

IDENTITY OF ERIOSOMA PYRI

Page

FIG. 1. Structural characters of the species of Prociphilus. *A*, *P. bumulae:* Distal segments of antenna of spring migrant. *B*, *P. poschingeri:* Distal segments of antenna of spring migrant. *C*, *P. venafuscus:* Distal segments of antenna of spring migrant. *D*, *P. venafuscus:* Distal segments of antenna of fall migrant. *E*, *P. pyri:* Distal segments of antenna of fall migrant. *F*, *P. xylostei:* Distal segments of antenna of spring migrant. *G*, *P. populiconduplifolius:* Distal segments of antenna. *H*, *P. corrugatans:* Distal segments of antenna of spring migrant. *I*, *P. corrugatans:* Distal segments of antenna of spring migrant. *J*, *P. alnifoliae:* Distal segments of antenna. *K*, *P. tessellatus:* Distal segments of antenna. *L*, *P. bumulae:* Thoracic wax plates. *M*, *P. poschingeri:* Thoracic wax plates. *N*, *P. xylostei:* Thoracic wax plates. *O*, *P. venafuscus:* Thoracic wax plates. *P*, *P. corrugatans:* Thoracic wax plates. *Q*, *P. pyri:* Thoracic wax plates. *R*, *P. alnifoliae:* Thoracic wax plates. *S*, *P. populiconduplifolius:* Thoracic wax plates. *T*, *P. tessellatus:* Thoracic wax plates..... 1117

A NEW IRRIGATION WEIR

FIG. 1. Plan, elevation, and section of concrete weir box in the hydraulic laboratory of the Colorado Experiment Station; also arrangement of experimental weir section for Nos. 1 to 6 and 13 to 16, in Table I 1128
2. Plan of experimental weir box for Nos. 7, 12, 18, 20, and 30 to 34 in Table I..... 1130
3. Plan of experimental weir box for Nos. 8 and 11, Table I..... 1130
4. Plan of experimental weir box for Nos. 9 and 10, Table I..... 1130
5. Plan of experimental weir box for No. 17, Table I..... 1131
6. Plan of experimental weir box for No. 19, Table I..... 1131
7. Plan of experimental weir box for Nos. 21, 22, 24, and 25, Table I..... 1131
8. Plan of experimental weir box for No. 27, Table I..... 1132
9. Plan of experimental weir box for No. 28, Table I..... 1132
10. Plan of experimental weir box for No. 29, Table I..... 1132
11. Plan of experimental weir box for No. 35, Table I..... 1133
12. Plan of experimental weir box for No. 36, Table I..... 1133
13. Plan of experimental weir box for No. 37, Table I..... 1133
14. Experimental discharge data plotted logarithmically and curves drawn from values computed from standard equation for new irrigation weir..... 1134
15. Coefficient and exponent values of individual discharge equations plotted against weir length..... 1135
16. Plan, elevation, and section (standard) of new irrigation weir box.... 1136

INHERITANCE OF FERTILITY IN SWINE

FIG. 1. Curve of litter frequencies in the P generation of swine..... 1156
2. Curve of litter frequencies in the F_1 generation of swine..... 1157
3. Curve of litter frequencies in the F_2 generation of swine..... 1157
4. Diagram of the combined litter frequencies for the three generations of swine analyzed into its component curves..... 1158

A NEW SPRAY NOZZLE

FIG. 1. Diagram showing the characteristic differences between the three forms of impinging-stream nozzles..... 1178

A New Interpretation of the Relationships of Temperature and Humidity to Insect Development

Page

Fig. 1. Graph showing the relations of temperature and humidity to cotton boll-weevil activity 1186

2. Graph showing the method of determining the zone of effective temperatures at a humidity of 56 per cent. 1187